Remarks:

Reconsideration of the application is requested.

Claims 1-7 remain in the application.

In the first paragraph on page 2 of the above-identified Office action, claims 1-7 have been rejected as being indefinite under 35 U.S.C. § 112.

More specifically, the Examiner has stated that these claims are vague and indefinite in that it is unclear what actual structure is defined by the term "etching structures". The Examiner further stated that it is noted that the term is used in the original disclosure, but no explanation or description is given. It is respectfully noted that the Examiner is in error. An explanation that the "etching structures" are lithographically produced can be found on page 7, lines 15-21 of the specification. There it is disclosed that the structures are present in the upper electrode or in a further layer applied thereto and denoted as additional layer 8. These **structures** are further defined in the specification between the last paragraph on page 7 through the first paragraph on page 9, where it is stated that the additional layer 8 is perforated by a multiplicity of holes 10. It is further disclosed that the essence of the **structure** (etching

structure) present is that the cutout regions of the **structured** layer and/or the remaining islands are arranged such that the desired setting of the resonant frequency is reached. Furthermore, Figs. 2 and 3 clearly illustrate the "etching structures". Therefore, the claims have not been amended to overcome the rejection.

In the fourth paragraph on page 2 of the Office action, claim 1 has been rejected as being fully anticipated by Bottom (U.S. Patent No. 4,130,771) under 35 U.S.C. § 102.

Also in the fourth paragraph on page 2 of the Office action, claim 1 has been rejected as being fully anticipated by Zimnicki et al. (U.S. Patent No. 6,249,074 B1) under 35 U.S.C. § 102.

In the sixth paragraph on page 2 of the Office action, claims 2-7 have been rejected as being obvious over Bottom (U.S. Patent No. 4,130,771) in view of Von Dach (U.S. Patent No. 4,562,370), Fujita et al. (U.S. Patent No. 4,638,205), Arvanitis (U.S. Patent No. 4,642,505) or under 35 U.S.C. § 103.

Also in the sixth paragraph on page 2 of the Office action, claims 2-7 have been rejected as being obvious over Zimnicki et al. (U.S. Patent No. 6,249,074 B1) in view of Von Dach

(U.S. Patent No. 4,562,370), Fujita et al. (U.S. Patent No. 4,638,205), Arvanitis (U.S. Patent No. 4,642,505) or under 35 U.S.C. § 103.

As will be explained below, it is believed that the claims were patentable over the cited art in their original form and the claims have, therefore, not been amended to overcome the references.

Before discussing the prior art in detail, it is believed that a brief review of the invention as claimed, would be helpful.

Claim 1 calls for, inter alia:

"an additional layer disposed on said upper electrode layer, said additional layer being structured with etching structures for setting a prescribed resonant frequency of the piezoelectric resonator."

The Bottom reference discloses a method of adjusting the frequency of a crystal resonator using the following steps: First, forming a selected crystal blank, e.g., an AT-cut quartz plate, and plating the crystal blank with aluminum contacts by evaporation deposition or sputtering to form an aluminum plated resonator. If this results in a frequency below the nominal frequency, some of the aluminum is etched

away until a frequency above the nominal frequency is reached (column 3, lines 45-59). This can be seen as a rough method to obtain a frequency somewhere above the nominal frequency. Next a fine-tuning step is completed by anodically forming an oxide film on the aluminum plating. The desired nominal frequency of the resonator is achieved in this method, step by step, which means that the oxidating procedure is continued as long as the actual frequency does not coincide with the nominal frequency (column 4, lines 1-11).

The reference does not show an additional layer disposed on the upper electrode layer, the additional layer being structured with etching structures for setting a prescribed resonant frequency of the piezoelectric resonator, as recited in claim 1 of the instant application. The Bottom reference discloses aluminum electrodes, which have to be a certain weight. If the weight exceeds the required weight, then etching ablates some of the material. The present invention does not adjust the electrode, and especially it does not etch the electrode. The Bottom et al. reference also discloses forming an oxide layer on the electrode, which due to its weight, reduces the frequency. This method reaches the desired frequency arriving from higher frequencies by reducing the frequency (as the weight is constantly increased).

This is contrary to the invention of the instant application, which deposits a layer on the electrode, which is then etched to a certain structure to reduce the weight. This method approaches the desired nominal frequency of the resonator arriving from lower frequencies by increasing the frequency (the weight is reduced). The Bottom et al. reference does not etch the mass-loading layer. The present invention as claimed discloses a method of etching structures without an oxidation process, whereas the Bottom et al. reference discloses a method consisting of oxidation and does not teach any method of etching structures.

Regarding the fourth paragraph on page 2 of the Office action, rejecting claim 1 over Zimnicki et al. (U.S. Patent No. 6,249,074 B1) under 35 U.S.C. § 102, it is noted that the Zimnicki et al. reference discloses a piezoelectric resonator using a sacrificial layer and a method of raising a resonator frequency to a desired target. The method consists of reducing the thickness of the layer by ablating some of the material by ion milling desputtering. Furthermore, the Zimnicki et al reference discloses that after tuning, the sacrificial layer has been greatly thinned (column 4, line 32). The Zimnicki et al. reference also discloses that the method requires a "diffusion barrier (18) interposed between the electrodes (14) and the sacrificial mass-loading layer (16)" (column 3, lines 29-31). This guarantees that the

uniform desputtering extends maximally to the diffusion barrier. This layer is required for the disclosed method to work. However, a diffusion barrier is not required in the present invention.

The reference does not show an additional layer disposed on the upper electrode layer, the additional layer being structured with etching structures for setting a prescribed resonant frequency of the piezoelectric resonator, as recited in claim 1 of the instant application. The Zimnicki et al. reference discloses raising the frequency of a resonator by reducing the thickness of a sacrificial layer by ablating some of the material by ion milling. There is no teaching of reducing the mass by etching a structure as claimed in the present invention. Furthermore, the Zimnicki et al. reference discloses ion milling tuning (column 6, line 14).

It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claim 1. Claim 1 is, therefore, believed to be patentable over the art and since all of the dependent claims are ultimately dependent on claim 1, they are believed to be patentable as well.

Although the claims are believed to be patentable, further discussion of the dependent claims is given below. The Bottom

reference discloses a method of reaching a desired frequency by constantly **adding** mass to the electrode until a certain frequency is achieved. Each of the Von Dach, Arvanitis and Fujita et al. references contradict the Bottom reference by disclosing different techniques of **ablating** mass. Therefore, no person of ordinary skill in the art would combine the teachings of the above-noted references, as the effort to do so would needlessly be twice as great as choosing only one method.

Regarding the rejections over Zimnicki et al. in view of Von Dach, Fujita et al. and Arvanitis, it is noted that the Arvanitis reference discloses a low frequency crystal filter comprising a thick piezoelectric bulk material (an "AT-cut quartz crystal wafer (12) is securely attached to the metal header (14) (column 3, lines 65-66)). Due to its fixation to the metal header (14) the quartz crystal filter must be thick enough to provide sufficient mechanical stability. As shown in Figs. 1 and 5a, one of the electrodes is structured by laser trimming to adjust the frequency of the filter.

Contrary thereto, the present invention teaches that a structured additional layer is provided on the upper electrode to set the frequency of the resonator. The prior art described by Arvanitis shows a patterned electrode (Fig. 3). It is the desire of Arvanitis to avoid any pattern and to cut

off a "contiguous area" (24) (column 2, lines 12-20 and column 5, line 54 to column 6, line 11). This is in contrast to the invention of the instant application, which teaches that a structured additional layer is provided on the upper electrode to set the frequency of the resonator.

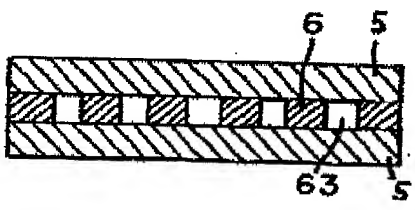
Furthermore, the "contiguous area" as well as the "spot pattern" of the prior art described by Arvanitis is formed by laser trimming. The spot size is roughly .5 mil, which reflects the minimum spot size of a laser. Due to the size of the laser spot, a structure as aimed at by the invention of the instant application cannot be formed by laser trimming, since the dimensions of the claimed thin film resonator are much smaller than the bulk resonator of Arvanitis.

Therefore, the invention of the instant application teaches lithographic formation of a structured additional layer, which has many advantages over Arvanitis. The advantages of using lithography include but are not limited to obtaining smaller dimensions, and lithography allows for mass production whereas laser trimming is a sequential writing tool only applicable for one resonator at a time. Another advantage can be found in a more "clean" formation process as the material is etched instead of ablated. Ablation intrinsically forms more dust and other particles, which may adhere to the resonator.

In summary a person of ordinary skill in the art would not combine the teachings of the Zimnicki et al. reference with the teachings of the Arvanitis reference as the Arvanitis reference refers to resonators of a size that is considerably larger than a thin film resonator. Furthermore, even if the references were combined, it would result in a resonator with a layer, which is either uniformly ablated by ion milling or exposed to a laser to remove a single contiguous area. This is contrary to the teachings of the invention of the instant application.

The Fujita et al. reference discloses a piezoelectric transducer used as a buzzer, whose operational frequency is about 3.1 kHz. This type of transducer is not a thin film resonator. The 70 μm thick piezoelectric ceramic sheet (6) is directly bonded to a vibrating reed (6) (Fig. 10). The electrode (4) covers the reed. The reed is not disposed on this electrode. Fujita et al. is not relevant prior art since the differences between a buzzer and a thin film resonator are considerable.

FIG. 10



The Von Dach reference discloses a method for adjusting the frequency of a piezoelectric crystal resonator of the tuning fork type (column 2, lines 31-35). The metal coating (12), which partially covers the crystal, is pierced by shots of a laser beam to adjust the frequency of the crystal resonator (column 1, lines 44-56; column 2, line 63 to column 3, line 4). The spot size is roughly 0.5 mil, which reflects the minimum spot size of a laser. Due to the size of the laser spot, laser trimming cannot be used to form a structure as disclosed in the present invention. Furthermore, the Von Dach reference does not disclose an additional layer disposed on an electrode.

In view of the foregoing, reconsideration and allowance of claims 1-7 are solicited.

In the event the Examiner should still find any of the claims to be unpatentable, counsel respectfully requests a telephone call so that, if possible, patentable language can be worked out.

Please charge any other fees which might be due with respect to Sections 1.16 and 1.17 to the Deposit Account of Lerner & Greenberg P.A., No. 12-1099.

Respectfully submitted,

LAURENCE A. GREENBERG
REG. NO. 29,308

For Applicant(s)

AKD:cgm

November 20, 2002

Lerner and Greenberg, P.A.
Post Office Box 2480
Hollywood, FL 33022-2480
Tel: (954) 925-1100
Fax: (954) 925-1101